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# THE EFFECT OF SEXUAL ABSTINENCE ON FEMALES' EDUCATIONAL ATTAINMENT\*

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*A number of studies have shown that teenagers who abstain from sex are more likely to graduate from high school and attend college than their sexually active peers. However, it is unclear whether this association represents a causal relationship or can be explained by unmeasured heterogeneity. We employ a variety of statistical techniques to distinguish between these hypotheses, using data on females from the National Longitudinal Study of Adolescent Health. Our results provide evidence that delaying first intercourse leads to an increased likelihood of graduating from high school. This relationship appears to be strongest among respondents in the bottom third of the ability distribution. Controlling for fertility reduces, but does not eliminate, the estimated effect of delaying intercourse.*

“When greater energy and interest are invested in sexual activity, the drive for academic performance is likely to diminish.” (Rector and Johnson 2005:20)

**D**uring the 1990s, sex education efforts in the United States became increasingly focused on promoting abstinence. For instance, a 1999 survey found that 41% of sex education teachers said that abstinence was the “most important message they wished to convey,” while a similar survey done in 1988 found that only 25% of sex education teachers considered abstinence to be their most important message (Darroch, Landry, and Singh 2000).

The Centers for Disease Control and Prevention (2004) described abstinence as the “surest way to avoid transmission of sexually transmitted diseases,” and abstinence is obviously an effective method of preventing unwanted pregnancies. However, teaching abstinence in schools has also been justified on the grounds that refraining from having sex as a teenager may impart important psychological and emotional benefits that, in turn, lead to increased human capital accumulation.

In fact, there is some evidence in support of this view. Rector and Johnson (2005) found that abstinent teens were more likely to graduate high school and more likely to go on to attend college than their sexually active peers. They argued that these findings were evidence that sexually active adolescents “become preoccupied with the present” (p. 20), while those “who abstain [are] subject to less emotional turmoil and fewer psychological distractions. . . .” (p. 3). However, Rector and Johnson could not rule out the possibility that the association between delaying first intercourse and educational attainment was due, at least in part, to unobserved factors, such as an individual’s inherent degree of risk aversion or ability to control his or her impulses.<sup>1</sup>

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1. Other studies that found a positive relationship between age at first intercourse and human capital accumulation include Upchurch and McCarthy (1990) and Dorius, Heaton, and Steffen (1993). Armour and Haynie (2007)

In this study, we use a sample of females drawn from the National Longitudinal Study of Adolescent Health to reexamine the relationship between delaying first intercourse and educational attainment, paying special attention to the role played by unobservable factors. In addition, we examine whether the estimated relationship between abstinence and educational attainment differs by ability or family background characteristics, and whether it is mediated by teenage fertility.

Our results suggest that females who delay having intercourse for one year experience a statistically significant increase in the likelihood of graduating from high school. This effect appears to be largest for females who are already at a disadvantage in terms of their cognitive ability. Controlling for teenage fertility reduces the estimated relationship between abstinence and educational attainment by approximately one-third.

## BACKGROUND

A number of studies have examined the relationship between age at first intercourse and measures of academic achievement, such as grades and high school graduation (Billy et al. 1988; Dorius et al. 1993; Rector and Johnson 2005; Sabia 2007; Schvaneveldt et al. 2001; Upchurch and McCarthy 1990). They provide evidence that teens who delay becoming sexually active tend to perform better academically than their peers who become sexually active at an earlier age. However, this finding should be interpreted cautiously. If unobserved factors (such as an individual's discount rate or degree of risk aversion) are correlated with both age at first intercourse and academic achievement, then the relationship between these variables is potentially spurious.

A related vein of research examines the relationship between teenage fertility and human capital accumulation. This relationship, too, might be driven by unobservable factors (such as an individual's discount rate), and studies have used a variety of methods to address the issue. For instance, several studies have examined samples of sister pairs (Geronimus and Korenman 1992; Hoffman, Foster, and Furstenberg 1993; Ribar 1999); other researchers have taken an instrumental variables approach (Klepinger, Lundberg, and Plotnick 1995, 1999; Olsen and Farkas 1989; Ribar 1994); and another group of studies have relied on natural experiments (Bronars and Grogger 1994; Grogger and Bronars 1993; Hotz, McElroy, and Sanders 2005; Hotz, Mullin, and Sanders 1997). Taken together, their results underline the important role played by unmeasured heterogeneity, but nonetheless suggest that teenage childbearing is associated with a substantial cost in terms of reduced human capital.<sup>2</sup>

The current study is the first to investigate the relationship between abstinence and educational attainment while accounting for the influence of unobservable factors by using methods similar to those adopted by researchers working in the teenage fertility literature. We begin our investigation by producing standard ordinary least squares (OLS) estimates of the effect of abstinence. Next, we add school fixed effects to the estimating equation and then, restricting our attention to sisters, family fixed effects. Finally, we take an instrumental variables approach, using age of menarche to identify exogenous variation in age at first intercourse.<sup>3</sup>

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found that teenagers who become sexually active at an early age are more likely to engage in delinquent behaviors such as destroying property and theft. The authors concluded that "early sexual debut is likely to occur before most adolescents are developmentally prepared to deal with the emotional and social consequences of initiating this behavior" (Armour and Haynie 2007:151).

2. Hoffman (1998) reviewed many of these studies. He wrote, "current research no longer supports the notion that teenage childbearing is a devastating event" (p. 239), but argued that it was premature to conclude that "the causal effects of teenage parenting are positive, zero, or even just marginally negative" (p. 243).

3. Because the primary instrument is age of menarche, the analysis is restricted to females.

## DATA

The data used in our analysis come from the National Longitudinal Study of Adolescent Health, conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill. The Adolescent Health data collection effort began with the identification of more than 26,000 high schools from across the United States. Eighty were selected from this population, and most were matched with a junior high or middle school from the same community, bringing the total number of participating schools to 132. From the student rosters of these 132 schools, a core sample was randomly chosen to be administered the Adolescent Health Wave I (baseline) in-home survey. In addition to this core sample, oversamples of black students with college-educated parents; Cuban and Puerto Rican students; and other groups were administered the Wave I in-home survey.

The Wave I in-home survey was completed by 20,746 adolescents between April and December of 1995. The final wave (the Wave III in-home survey) of the National Longitudinal Study of Adolescent Health was administered in 2001, when respondents were between the ages of 18 and 28.<sup>4</sup> Our sample is limited to females who completed the baseline Adolescent Health interview, had a nonmissing Wave III sample weight, and provided sufficient information at Wave III on abstinence and school attainment to construct the variables used in the analyses described below ( $n = 7,444$ ).<sup>5</sup>

Two dichotomous outcomes were constructed from the Adolescent Health data. The first is equal to 1 if the respondent had received a high school diploma by the time of the Wave III survey in 2001, and equal to 0 if she dropped out; the second is equal to 1 if the respondent was attending college at the time of the Wave III survey or had completed at least one year of college prior to the survey.<sup>6</sup>

The independent variables of interest are *Abstained* and *Age at First Intercourse*. The variable *Abstained* is equal to 1 if an individual refrained from having intercourse until at least the age of 18, and equal to 0 otherwise. Nearly 40% of respondents reported abstaining from sex until at least age 18. The second variable was created only for respondents who reported being sexually active when interviewed at Wave III (88% of the full sample reported being sexually active at Wave III). For these respondents, we constructed a continuous measure, *Age at First Intercourse*, based on their response to the question, "How old were you the first time you had vaginal intercourse?" For this subsample, the mean age of first intercourse was 16.4 years.

Table 1 presents descriptive statistics for the variables *Age at First Intercourse* and *Abstained* by educational attainment. They suggest that age at first intercourse is positively related to educational attainment. For instance, the typical high school graduate first had sex at 16.6 years of age, whereas the typical dropout first had sex at 15.5 years of age. There is evidence of a similar relationship between abstaining from sex until the age of 18 and educational attainment. For instance, 46% of high school graduates abstained from sex until the age of 18, as compared with 25% of dropouts.<sup>7</sup>

4. Further information regarding the Adolescent Health data collection effort is available from a variety of sources. See, for instance, Harris, Duncan, and Boisjoly (2002) and Harris et al. (n.d.).

5. Four hundred sixty-seven female respondents were dropped because of missing information at Wave III on the sample weight. Another 108 were dropped because of missing information on age at first intercourse. Six more respondents were dropped from the analysis because of missing information at Wave III on school attainment.

6. A small number of respondents ( $n = 5$ ) were excluded from the analysis because they were still attending high school when the Wave III survey was administered in 2001. Inclusion of these respondents in the analysis did not qualitatively change our results. Because 13.5% of the respondents were still teenagers when interviewed at Wave III, it is likely that some proportion subsequently graduated high school and went on to attend college. Restricting the sample to respondents who were at least 20 years of age at the time of the Wave III interview produced qualitatively similar estimates of the relationship between abstinence and educational attainment as those presented in this article.

7. Appendix Table A1 presents descriptive statistics for all the variables used in the analysis.

**Table 1.** Mean Age at First Intercourse and Abstinence Rates by Educational Attainment

Variable	High School Graduate (1)	High School Dropout (2)	College (3)	No College (4)
Age at First Intercourse	16.6 (2.17) [5,492]	15.5 (2.05) [1,063]	16.8 (2.21) [4,040]	15.8 (2.02) [2,515]
Abstained	0.412 (0.492) [6,303]	0.223 (0.417) [1,141]	0.461 (0.499) [4,731]	0.250 (0.433) [2,713]

Notes: Standard deviations are in parentheses, and sample sizes are in brackets. Means are weighted and are based on data drawn from Wave III of the National Longitudinal Study of Adolescent Health.

## ESTIMATION STRATEGIES

### Ordinary Least Squares

As a benchmark, we begin our analysis by replicating the results from previous studies on the effects of abstinence. Specifically, we use OLS to estimate

$$E_i = \beta_0 + \beta'_1 \mathbf{X}_i + \beta_2 \text{Abstained}_i + \varepsilon_i, \quad (1)$$

where  $E_i$  is a measure of educational attainment constructed from answers to the Wave III survey;  $\mathbf{X}_i$  is a vector of controls; and  $\text{Abstained}_i$  is a variable equal to 1 if respondent  $i$  had not had sex by the age of 18, and equal to 0 otherwise. In an alternative set of estimations, the sample is restricted to respondents who had had sex by the time of the Wave III survey and the variable  $\text{Abstained}$  is replaced with *Age at First Intercourse*.

The variables in  $\mathbf{X}_i$  include age at the time of the Wave III survey, household income (during adolescence), parental educational attainment, parental marital status, urbanicity, region, religiosity, race, appearance (as judged by the interviewer), number of biological siblings, whether the respondent has an older sibling, height, weight, an abridged version of the Peabody Picture and Vocabulary Test (PPVT), whether the respondent attended a public school, school size, average class size, and the proportion of students in the respondent's school who were enrolled in college preparatory courses.<sup>8</sup>

### School Fixed Effects

It is easy to imagine that difficult-to-measure factors at the school or neighborhood level could influence both the decision to become sexually active and human capital accumulation. For example, some schools could devote more resources than other schools to teaching students how to control their impulsive behaviors.<sup>9</sup> A solution to this problem is to augment Eq. (1) with school fixed effects:

8. All control variables were constructed using data from the Wave I survey.

9. A recent *New York Times* article described efforts at Briarcliff Middle School in Westchester County, NY, to teach social and emotional development (Hu 2007):

Briarcliff Middle School has extorted students to live by the 16 traits that are at the core of Habits of Mind, traits that its supporters contend are common to highly successful people. From "thinking flexibly" and "taking responsible risks" to "managing impulsivity," these traits are posted on signs around the school . . . Briarcliff is hardly alone in emphasizing social and emotional learning. For instance, more than 4,000 schools worldwide have embraced an alternative program, Tribes Learning Communities, which teaches students to work well together in a group by using skills such as listening, reflecting and problem-solving.

$$E_{is} = \beta_0 + \beta'_1 \mathbf{X}_i + \beta_2 \text{Abstained}_i + \boldsymbol{\gamma}_s + \varepsilon_{is}, \quad (2)$$

where  $s$  denotes respondents  $i$ 's middle or high school at the time of the Wave I survey, and  $\boldsymbol{\gamma}_s$  is a vector of school indicators. Although this identification strategy eliminates one potentially important source of unmeasured heterogeneity,  $\hat{\beta}_2$  may still be biased because of the influence of family- or individual-level unobservable factors.

### Family Fixed Effects

The results of several studies comparing sisters suggested that estimated relationship between teenage childbearing and human educational attainment is reduced substantially when family-level unobservable factors are taken into account (Hoffman 1998). To control for family-level unobservable factors, we examine a sample composed of sisters<sup>10</sup> and estimate

$$E_{ij} = \beta_0 + \beta'_1 \mathbf{X}_i + \beta_2 \text{Abstained}_{ij} + \boldsymbol{\kappa}_j + \varepsilon_{ij}, \quad (3)$$

where  $j$  denotes the individual's family, and  $\boldsymbol{\kappa}_j$  is a vector of family fixed effects.<sup>11</sup> However, as noted by Hoffman (1998:237), "[t]his method is not perfect, because even sisters are not exactly alike," and their differences could be correlated with both the decision to become sexually active and educational attainment. For example, one sister may be more future oriented than the other and, as a consequence, may be more likely to delay first intercourse and more likely to focus on school. This would bias family fixed effects estimates upward.

Another drawback to adding family fixed effects to the estimating model is that it involves a large reduction in sample size. As noted by Klepinger et al. (1999:424), this reduction, coupled with restricting the sample to respondents with siblings, may "reduce the efficiency of estimates, and may introduce sample selection bias." For instance, the relationship between abstinence and educational attainment among only children, who benefit from the quantity-quality trade-off, could be weaker than that among respondents from larger families.

### Instrumental Variables

The final identification strategy pursued is to drop the vector of family fixed effects,  $\boldsymbol{\kappa}_j$ , from the human capital equation and identify a set of instruments,  $\mathbf{Z}_i$ , that are correlated with the decision to refrain from sexual activity but uncorrelated with the error term of Eq. (1). If the decision to abstain from sex until the age of 18 is given by

$$\text{Abstained}_i = \gamma_0 + \boldsymbol{\gamma}'_1 \mathbf{X}_i + \boldsymbol{\gamma}'_2 \mathbf{Z}_i + \varepsilon_i, \quad (4)$$

then an alternative estimate of  $\beta_2$  can be obtained by using the full sample and instrumental variables (two-stage least squares) estimation. This strategy will produce a consistent estimate of the effect of abstinence on educational attainment provided that appropriate instruments can be found.

Our key instrument is age of menarche, which, controlling for weight, is assumed to have no direct effect on educational attainment. This assumption has been employed by a number of previous researchers. For instance, Klepinger et al. (1999:431), who used age of menarche as an instrument for fertility, wrote that age of menarche is "an individual characteristic

10. Sisters are defined as nontwin full siblings, fraternal twins, identical twins, twins of uncertain zygosity, and half siblings.

11. The variables in the vector  $\mathbf{X}_i$  include age at Wave I, PPVT score, religiosity, race, height, weight, average class size, whether the respondent attended a public school, percentage of students in the respondent's school who were enrolled in college preparatory classes, school size, whether the respondent had an older sibling, and attractiveness as rated by the Adolescent Health interviewer. The family fixed effects capture the influence of factors common to sister pairs, such as family size.

likely to affect childbearing but not educational attainment or work experience.”<sup>12</sup> Moreover, to ensure that age of menarche does not affect educational attainment through other weight-related channels (Adair and Gordon-Larsen 2001; Anderson, Dallal, and Must 2001; Striegel-Moore et al. 2001), we examine the robustness of our findings to adding controls for bulimia, being underweight, and being overweight.

There is strong evidence in the literature that age of menarche is related to the timing of first intercourse. Researchers such as Averett, Rees, and Argys (2002), Phinney et al. (1990), Soefer et al. (1985), and Zabin et al. (1986) have documented a positive relationship between age of menarche and age at first intercourse, and Phinney et al. (1990) and Presser (1978) found that age of menarche is related to the dating behavior of adolescent females. According to Zabin et al. (1986:603), “because of individually based factors associated with pubertal development, adolescents become sexually motivated and are perceived by others as potential sex partners. As a result, early maturers are more likely to become sexually involved at a younger age than those who mature at a later age.”

In addition to age of menarche, previous researchers have employed instruments reflecting the availability of family planning and abortion services to identify exogenous variation in fertility. Following Klepinger et al. (1999) and Ribar (1994), we experiment with including measures of the availability of family planning and abortion services in the vector  $Z_i$ . We hypothesize that these measures capture some portion of the cost of becoming sexually active, and that as this cost rises, adolescents will be more likely to remain abstinent.

## RESULTS

OLS estimates of the relationship between delaying first intercourse and educational attainment are presented in Table 2. In columns 1 and 2, age at first intercourse is the independent variable of interest; therefore, the sample is restricted to respondents who were sexually active by Wave III. In columns 3 and 4, the focus is on respondents who remained abstinent until age 18; therefore, estimates for the full sample are presented.<sup>13</sup>

Interpreted naively, OLS estimates suggest that delaying first intercourse leads to increases in educational attainment. Among respondents who were sexually active at Wave III, abstaining from sex for an additional year is associated with a .029 increase in the probability of graduating from high school and a .036 increase in the probability of attending college. In the full sample, abstaining from having sex until at least age 18 is associated with a .098 increase in the probability of graduating from high school and a .170 increase in the probability of attending college.<sup>14</sup>

These results are consistent with those found by Dorius et al. (1993), Rector and Johnson (2005), and Upchurch and McCarthy (1990). However, in theory, they could be partly or even entirely a reflection of unmeasured heterogeneity. We examine this issue below by using the statistical techniques described in the previous section.

Table 3 presents estimates of Eq. (2), which includes school fixed effects. For the purposes of comparison, OLS estimates from Table 2 are also presented. Although the school effects are always jointly significant, the abstinence estimates are not qualitatively or statistically different from the corresponding OLS estimates. This pattern of results suggests that

12. See also Klepinger et al. (1995) and Ribar (1994). These authors employed age of menarche as an instrument for fertility and assumed that it was not directly related to educational attainment.

13. Throughout the article, regression estimates are based on weighted data using the Wave III sample weights. Standard errors are corrected for clustering at the school level.

14. When respondents with a GED were defined as having completed high school, the estimated effect of abstinence tended to be smaller in magnitude, but nevertheless statistically significant. Estimating single-equation probit models produces results similar to those reported in Table 2. For instance, delaying first intercourse for one year is associated with a statistically significant .030 increase in the probability of high school completion ( $p$  value = .00).



**Table 2. Ordinary Least Squares (OLS) Estimates of the Relationship Between First Sexual Intercourse and Educational Attainment**

Variable	Sexually Active		Full Sample	
	High School (1)	College (2)	High School (3)	College (4)
Age at First Intercourse	0.029** (0.003)	0.036** (0.003)	—	—
Abstained	—	—	0.098** (0.011)	0.170** (0.016)
Age at Wave III	0.002 (0.004)	-0.008 (0.005)	0.003 (0.004)	-0.008 <sup>†</sup> (0.005)
Log Household Income	0.042** (0.011)	0.056** (0.015)	0.040** (0.010)	0.053** (0.014)
Parent Completed High School	0.094** (0.026)	0.111** (0.023)	0.102** (0.025)	0.122** (0.022)
Parent Attended Trade School	0.150** (0.027)	0.214** (0.033)	0.152** (0.027)	0.220** (0.031)
Parent Completed Some College	0.165** (0.026)	0.227** (0.026)	0.168** (0.025)	0.227** (0.024)
Parent Completed College	0.127** (0.027)	0.279** (0.030)	0.158** (0.028)	0.280** (0.028)
Parent Has a Post-College Education	0.127** (0.027)	0.320** (0.032)	0.145** (0.026)	0.324** (0.029)
Parent Is Single	0.008 (0.039)	-0.022 (0.034)	0.001 (0.034)	-0.032 (0.031)
Parent Is Divorced	0.010 (0.021)	-0.023 (0.025)	-0.004 (0.020)	-0.033 (0.024)
Parent Is Separated	-0.038 (0.033)	-0.063 (0.040)	-0.055 <sup>†</sup> (0.033)	-0.074* (0.037)
Parent Is Widowed	0.010 (0.038)	0.032 (0.040)	0.021 (0.036)	0.020 (0.035)
PPVT Score	0.004** (0.0005)	0.008** (0.0006)	0.004** (0.0005)	0.008** (0.0005)
Rural	0.058* (0.022)	0.026 (0.036)	0.045* (0.020)	0.038 (0.032)
Suburban	0.040* (0.017)	0.032 (0.028)	0.025 (0.037)	0.034 (0.026)
West	0.0002 (0.023)	-0.043 (0.030)	-0.009 (0.021)	-0.044 <sup>†</sup> (0.027)
Midwest	-0.031 <sup>†</sup> (0.017)	-0.039 (0.033)	-0.039* (0.017)	-0.049 (0.030)
South	0.002 (0.018)	0.003 (0.027)	-0.004 (0.018)	-0.009 (0.025)
Catholic	0.066** (0.020)	0.130** (0.025)	0.076** (0.020)	0.132** (0.024)

*(continued)*

(Table 2, continued)

Variable	Sexually Active		Full Sample	
	High School (1)	College (2)	High School (3)	College (4)
Baptist or Methodist	-0.010 (0.021)	0.037 <sup>†</sup> (0.023)	0.006 (0.022)	0.059** (0.022)
Other Christian	0.003 (0.023)	0.060* (0.027)	0.024 (0.023)	0.077** (0.026)
Non-Christian Religion	-0.022 (0.037)	0.121* (0.053)	-0.003 (0.034)	0.131** (0.047)
Black	0.084** (0.018)	0.122** (0.024)	0.081** (0.018)	0.109** (0.023)
Asian	0.048 (0.039)	0.076 <sup>†</sup> (0.045)	0.056 <sup>†</sup> (0.033)	0.100** (0.038)
Indian	0.022 (0.059)	0.053 (0.064)	-0.0004 (0.057)	0.021 (0.051)
Hispanic/Other	-0.042 <sup>†</sup> (0.023)	0.021 (0.029)	-0.025 (0.021)	0.021 (0.027)
Height (inches)	-0.0002 (0.002)	0.004 (0.003)	0.002 (0.002)	0.004 <sup>†</sup> (0.003)
Weight (pounds)	-0.0003 (0.0003)	-0.001** (0.0003)	-0.0003 (0.0002)	-0.001* (0.0003)
Class Size	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)	0.003 (0.002)
Public School	-0.023 (0.030)	-0.059 (0.037)	-0.025 (0.027)	-0.071* (0.036)
% Enrolled in College Preparatory Courses	0.0002 (0.0002)	0.001** (0.0003)	0.0002 (0.0002)	0.001** (0.0003)
Small School Size	0.016 (0.027)	-0.017 (0.045)	0.008 (0.024)	-0.029 (0.043)
Medium School Size	0.010 (0.019)	0.012 (0.027)	0.010 (0.017)	0.010 (0.024)
Number of Biological Siblings	0.002 (0.018)	-0.005 (0.007)	-0.0004 (0.005)	-0.006 (0.006)
Whether Has an Older Sibling	0.009 (0.013)	0.019 (0.015)	0.011 (0.013)	0.016 (0.014)
Very Unattractive	0.048 (0.040)	0.174** (0.048)	0.049 (0.036)	0.171** (0.043)
Unattractive	-0.034 (0.038)	-0.076 <sup>†</sup> (0.040)	-0.055 (0.036)	-0.104** (0.034)
Attractive	0.035** (0.013)	0.067** (0.018)	0.030* (0.012)	0.060** (0.016)
Very Attractive	0.037* (0.018)	0.061** (0.022)	0.033* (0.016)	0.060** (0.021)

(continued)



Table 2, continued)

Variable	Sexually Active		Full Sample	
	High School (1)	College (2)	High School (3)	College (4)
R <sup>2</sup>	.14	.25	.13	.26
N	6,555	6,555	7,444	7,444

Notes: Standard errors corrected for clustering at the school level are in parentheses. Estimates are from weighted OLS regressions based on data from Waves I and III of the National Longitudinal Study of Adolescent Health. The sample includes respondents with nonmissing information on abstinence and educational attainment. The parental education variables are based on the educational attainment of the parent (usually the mother) who completed the Adolescent Health parental questionnaire. The missing parental education category is composed of respondents whose parent received less than a high school education; the omitted family structure category is composed of respondents whose parent was married at the time of the Wave I survey; the omitted urbanicity category is composed of respondents who, according to the School Administrator survey, attended a school in an urban area; the omitted region category is composed of respondents who lived in the Northeast at the time of the Wave I survey; the omitted religion category is composed of respondents who did not indicate a religion; the omitted ethnicity/race category is composed of respondents who identified themselves as non-Hispanic white; the omitted school size is composed of respondents who attended schools with more than 1,000 students; and the omitted appearance category is composed of respondents whose interviewer rated them of "average" appearance. Dummy variables for missing information on the control variables are included but not shown.

<sup>†</sup>  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$

Table 3. School Fixed-Effects Estimates of the Relationship Between First Sexual Intercourse and Educational Attainment

Variable	High School		College	
	OLS (1)	School Fixed Effects (2)	OLS (3)	School Fixed Effects (4)
Panel 1. Age at First Intercourse	0.029** (0.003) [6,555]	0.029** (0.003) [6,555]	0.036** (0.003) [6,555]	0.032** (0.004) [6,555]
Panel 2. Abstained	0.098** (0.011) [7,444]	0.094** (0.011) [7,444]	0.170** (0.016) [7,444]	0.158** (0.017) [7,444]

Notes: Standard errors corrected for clustering at the school level are in parentheses. Sample sizes are in brackets. Estimates are from weighted OLS regressions based on data drawn from Waves I and III of the National Longitudinal Study of Adolescent Health. The full set of controls is given in Table 2.

\*\*  $p < .01$

schools (or local neighborhoods) play an important role in the determination of educational attainment but that their influence is largely orthogonal to the decision to abstain from sex.

Table 4 presents estimates of Eq. (3), which includes family fixed effects.<sup>15</sup> The sample used in Panel 1 of Table 4 is composed of 478 sisters, all of whom were sexually active by Wave III, belonging to 235 families.<sup>16</sup> The sample used in Panel 2 is composed of 256

15. Because the school fixed effects are highly colinear with the family fixed effects and with the indicator for whether the respondent has an older sibling, they are not included. Their inclusion, however, leaves the results qualitatively unchanged. For instance, when family and school fixed effects are included, the estimated effect of age at first intercourse on college attendance is 0.049, with a standard error of 0.029 ( $p$  value = .09).

16. Following Geronimus and Korenman (1992), who examined the effect of teenage fertility on educational attainment and other outcomes, this sample includes only siblings who became sexually active at different ages.

**Table 4.** Family Fixed-Effects Estimates of the Relationship Between First Sexual Intercourse and Educational Attainment

Variable	High School			College		
	OLS (1)	School Fixed Effects (2)	Family Fixed Effects (3)	OLS (4)	School Fixed Effects (5)	Family Fixed Effects (6)
Panel 1. Age at First Intercourse	0.027* (0.011) [478]	0.006 (0.013) [478]	0.001 (0.015) [478]	0.036* (0.015) [478]	0.020 (0.019) [478]	0.054* (0.023) [478]
Panel 2. Abstained	-0.007 (0.044) [256]	-0.059 (0.049) [256]	-0.015 (0.052) [256]	0.216** (0.081) [256]	0.182 (0.117) [256]	0.194 (0.130) [256]

Notes: Standard errors corrected for clustering at the family level are in parentheses. Sample sizes are in brackets. Estimates are from weighted OLS regressions based on data drawn from Waves I and III of the National Longitudinal Study of Adolescent Health. The full set of controls given in Table 2 is included in OLS and school fixed-effects models. In family fixed-effects models, controls were included for age, PPVT score, religiosity, race, height, weight, average class size, whether the respondent attended a public school, percentage of students in the respondent's school who were enrolled in college preparatory courses, school size, whether the respondent had an older sibling, and attractiveness of the respondent as rated by the interviewer.

\* $p < .05$ ; \*\* $p < .01$

sisters belonging to 127 families. For the purposes of comparison, OLS estimates based on these samples are also presented, as are estimates that control for school fixed effects.

OLS estimates presented in Table 4 suggest that delaying intercourse for an additional year is associated with a .027 increase in the probability of completing high school. However, controlling for family (or school) fixed effects sharply attenuates this relationship. In contrast, the estimated relationship between *Age at First Intercourse* and the probability of college attendance is robust to controlling for family fixed effects. Specifically, delaying intercourse for an additional year is associated with a .054 increase in the probability of going to college, an estimate that is quite a bit larger than the corresponding OLS estimate. Finally, there is little evidence that abstaining from sex until age 18 is related to either of the educational outcomes when our attention is restricted to sisters and either family or school fixed effects are included on the right-hand side of the estimating equation.

The estimates presented in Panel 1 of Table 4 suggest that a substantial portion of the relationship between *Age at First Intercourse* and high school graduation can be explained by school- and family-level unobservable factors. However, these estimates are based on a much smaller number of observations than those presented in previous tables, and may not be generalizable because the analysis is restricted to respondents who have sisters (Kleping et al. 1999).

An alternative estimation strategy is to employ two-stage least squares (2SLS) estimation with age of menarche as the instrument. Columns 1 and 2 of Table 5 present first-stage results. Consistent with the findings of previous researchers (Averett et al. 2002; Phinney et al. 1990; Soefer et al. 1985; Zabin et al. 1986), age of menarche is a strong predictor of sexual behavior. Among respondents who were sexually active by Wave III, a one-year increase in age of menarche is associated with delaying first intercourse for 0.187 years; in the full sample, it is associated with a .025 increase in the probability of abstaining from sex until age 18. *F* statistics (reported in Table 6) indicate that age of menarche clearly

A similar restriction was applied when examining the relationship between abstaining from sex until age 18 and educational attainment.

**Table 5.** Estimated Relationship Between Age of Menarche, Abstinence Variables, and Educational Outcomes

Variable	Age at First Intercourse (1)	Abstained (2)	High School (3)	College (4)
Age of Menarche	0.187** (0.019)	0.025** (0.004)	0.003 (0.004)	-0.005 (0.005)
Age at First Intercourse	—	—	0.028** (0.003)	0.036** (0.003)
<i>N</i>	6,440	7,308	6,440	6,440

*Notes:* Standard errors corrected for clustering at the school level are in parentheses. Estimates are from weighted OLS regressions based on data drawn from Waves I and III of the National Longitudinal Study of Adolescent Health. The sample includes respondents with nonmissing information on abstinence, educational attainment, and age of menarche ( $\leq 20$ ). The full set of controls is given in Table 2.

\*\* $p < .01$

satisfies the instrument relevance standards proposed by Bound, Jaeger, and Baker (1995) and Staiger and Stock (1997).

Columns 3 and 4 of Table 5 show estimates from regressing the educational outcomes on age of menarche, age at first intercourse, and the variables in the vector  $\mathbf{X}_i$ . There is little evidence that age of menarche is directly related to either high school graduation or college attendance.<sup>17</sup> These results suggest that using age of menarche to isolate exogenous variation in the timing of first intercourse is a valid estimation strategy.

The second-stage estimates are presented in Table 6. When the sample is restricted to respondents who were sexually active by Wave III, abstaining from sex for an additional year is associated with a .046 increase in the probability of graduating from high school, an estimate that is statistically indistinguishable from that obtained using OLS (according to a Hausman test).<sup>18</sup> The 2SLS estimate, however, is not statistically significant in the college attendance equation and is roughly one-third the size of the corresponding OLS estimate.

In the full sample, remaining abstinent until age 18 is associated with a .285 increase in the probability of graduating from high school.<sup>19</sup> Again, the 2SLS estimate is not statistically distinguishable from that obtained using OLS (according to a Hausman test). Abstinence until age 18 is also associated with a .081 increase in the probability of attending college. However, this estimate is not significant at conventional levels, nor is it statistically distinguishable from the estimate obtained using OLS.

### Robustness Tests

To this point in the empirical analysis, we have assumed that the age of menarche is related to educational attainment only through sexual intercourse. However, there is evidence that the early onset of sexual maturation may be associated with obesity or being overweight (Adair and Gordon-Larsen 2001; Anderson et al. 2001), and that late onset

17. In addition, we regressed the educational outcomes on age of menarche, *Abstained*, and the controls. The results were qualitatively similar to those reported in columns 3 and 4 of Table 5.

18. Estimating an instrumental variables (IV) probit model produced a similar result: abstaining from sex for an additional year was associated with a .023 increase in the probability of graduating from high school (standard error = .013;  $p$  value = .07). Unweighted regression results also produced similar results. The unweighted OLS estimate of the effect of age at first intercourse on high school graduation was .024, with a standard error of .002 ( $p$  value = .00); the unweighted 2SLS estimate of this effect was .027, with a standard error of .014 ( $p$  value = .04).

19. Estimating an IV probit model produces a similar result: abstaining from sex until age 18 is associated with a .179 increase in the probability of graduating from high school (standard error = .082;  $p$  value = .03).

**Table 6. Two-Stage Least Squares (2SLS) Estimates of Relationship Between First Sexual Intercourse and Educational Attainment**

Variable	High School		College	
	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)
Panel 1. Age at First Intercourse	0.029** (0.003) [6,440]	0.046* (0.022) [6,440]	0.036** (0.033) [6,440]	0.010 (0.025) [6,440]
<i>F</i> statistic on age of menarche (first-stage)		<i>F</i> = 101.6		<i>F</i> = 101.6
Panel 2. Abstained	0.097** (0.011) [7,308]	0.285* (0.146) [7,308]	0.171** (0.016) [7,308]	0.081 (0.162) [7,308]
<i>F</i> statistic on age of menarche (first-stage)		<i>F</i> = 41.6		<i>F</i> = 41.6

Notes: Standard errors corrected for clustering at the school level are in parentheses. Sample sizes are in brackets. Estimates are from weighted 2SLS regressions based on data drawn from Waves I and III of the National Longitudinal Study of Adolescent Health. The full set of controls is given in Table 2.

\* $p < .05$ ; \*\* $p < .01$

of sexual maturation may be associated with bulimia or being extremely underweight (Striegel-Moore et al. 2001).

To ensure that our key instrument is uncorrelated with the error term of Eq. (2), *Weight* was replaced by the following controls: whether the respondent made herself vomit to lose weight or to keep from gaining weight, was severely underweight, was underweight, was overweight, or was obese.<sup>20</sup> The results are presented in Panel 1 of Table 7 and are very similar to those in Table 6, suggesting that age of menarche is not related to educational attainment through this route.

As noted, researchers interested in the relationship between teenage fertility and educational attainment have employed instruments, in addition to age of menarche, that reflect the availability of family planning and abortion services. Panel 2 of Table 7 reports the results of adding three such variables to the vector  $\mathbf{Z}_i$ : the number of family planning service providers per 10,000 population in the respondent's county of residence; a dichotomous variable equal to 1 if the respondent's school had a policy of providing students with or referring students to family planning services, and equal to 0 otherwise; and a dichotomous variable equal to 1 if there was an abortion provider in the respondent's county of residence who performed at least 400 abortions, and equal to 0 otherwise.<sup>21</sup> These variables, intended to capture school- and county-level differences in the expected cost of becoming sexually active, are assumed to have no direct effect on educational attainment. Their inclusion in the vector  $\mathbf{Z}_i$  has no appreciable effect on the 2SLS estimates. In addition, their inclusion allows us to perform overidentifying restrictions tests, which indicate that the instruments are uncorrelated with the residuals of the education equation.<sup>22</sup>

20. The bulimia indicator was based on responses to the Wave III Adolescent Health survey. The weight indicators were based on the respondent's Body Mass Index at the time of the Wave I survey and CDC charts available at <http://www.cdc.gov/growthcharts>.

21. Sabia (2007) used a similar set of instruments when examining the effect of sexual activity on academic performance as measured by the respondent's grade point average.

22. Because *Abstained* is defined based on having had vaginal intercourse, we experimented with dropping from the analysis respondents who reported being attracted to women at Wave III. With this restriction, the 2SLS estimate of the effect of age at first intercourse on high school completion is .051, with a standard error of .021 ( $p$  value = .02).

**Table 7. Exploring the Robustness of Two-Stage Least Squares Estimates**

Variable	Age at First Intercourse		Abstained	
	High School (1)	College (2)	High School (3)	College (4)
Panel 1. Added Health Controls				
Effect of abstinence	0.049* (0.022) [6,440]	0.013 (0.025) [6,440]	0.310* (0.152) [7,308]	0.095 (0.171) [7,308]
<i>F</i> statistic on age of menarche (first-stage)	97.8	97.8	38.6	38.6
Panel 2. Policy Instruments				
Effect of abstinence	0.052* (0.021) [6,409]	0.009 (0.027) [6,409]	0.317* (0.136) [7,276]	0.082 (0.180) [7,276]
<i>F</i> statistic on exclusion restrictions (first-stage)	24.2	24.2	11.5	11.5
Hansen <i>J</i> statistic	1.26	0.275	2.70	0.171
<i>p</i> value on overid test	.73	.96	.44	.98

*Notes:* Standard errors corrected for clustering at the school level are in parentheses. Sample sizes are in brackets. Estimates are from weighted 2SLS regressions based on data drawn from Waves I and III of the National Longitudinal Study of Adolescent Health. In Panel 1, the control *Weight* is replaced by the variables *Severely Underweight*, *Underweight*, *Overweight*, *Obese*, and *Bulimia*. Otherwise, the controls listed in Table 2 are included. In Panel 2, three additional instruments are used: (1) whether the respondent's school provided or referred students to family planning services, (2) the number of family planning providers per 10,000 population in the respondent's county of residence, and (3) whether there was an abortion provider in the respondent's county of residence who provided 400 or more abortions.

\* $p < .05$

### The Effect of Abstinence by Cognitive Ability and Family Background Characteristics

The 2SLS results discussed above suggest that delaying first intercourse for an additional year leads, on average, to an increase in the probability of graduating high school of 4.6 percentage points. However, delaying first intercourse may not have the same effect across respondents. For instance, adolescents with lower cognitive ability may be less able to cope with physical or psychological costs of sex than their higher-ability counterparts. In Table 8, guided by the hypothesis that respondents who are already at risk of dropping out should benefit the most from abstinence, we explore whether the estimated relationship between age at first intercourse and educational attainment depends on cognitive ability, parental education, family structure, or household income. Prior research has shown that these factors are important predictors of educational attainment in general, and high school graduation in particular (Eckstein and Wolpin 1999; Haveman, Wolfe, and Spaulding 1991; Manski et al. 1992; Wilson 2001).

First, we divide respondents into three groups based on their Peabody Picture Vocabulary Test (PPVT) score, a measure of cognitive ability.<sup>23</sup> The results provide evidence that the relationship between age at first intercourse and high school graduation is

23. Adolescent Health respondents took an abridged version of the PPVT, which measures verbal comprehension and vocabulary. The PPVT is conducted by an interviewer who reads a word to a respondent and then has the respondent choose among four illustrations to determine the picture that best fits the word. The PPVT consists of 78 items (Harris and Thomas 2002). Adolescent Health respondents were administered 39 of these 78 items.

Table 8. Examining the Effect of Abstinence on High School Completion by Ability Level and Family Background Characteristics

	All (1)	Low Ability (2)	Medium Ability (3)	High Ability (4)	Parent Has Less Than High School Education (5)	Parent Has More Than High School Education (6)	Parent Not Married (7)	Parent Married (8)	Income Less Than or Equal to Median (9)	Income Greater Than Median (10)
Age at First Intercourse	0.046* (0.022) [6,178]	0.061† (0.031) [2,153]	0.054 (0.044) [2,059]	-0.005 (0.039) [1,966]	0.073* (0.033) [2,646]	-0.028 (0.031) [2,851]	0.052 (0.035) [1,609]	0.037 (0.032) [3,913]	0.021 (0.033) [2,400]	0.052† (0.027) [2,385]
F statistic on age of menarche (first-stage)	90.2	57.5	18.1	14.6	41.0	25.4	27.1	45.8	38.8	26.0

Notes: Standard errors corrected for clustering at the school level are in parentheses. Sample sizes are in brackets. Estimates are from weighted 2SLS regressions based on data from Waves I and III of the National Longitudinal Study of Adolescent Health. Although not shown, the controls listed in Table 2 and Panel I of Table 6 are included. Respondents with missing PPVT information were excluded from the analysis in columns (1)–(4). The low-, medium-, and high-ability categories were created by dividing the sample into thirds based on the PPVT distribution of respondents. Respondents with missing parent education information were excluded from the analysis in columns (5) and (6); respondents with missing parent marital status information were excluded from columns (7) and (8); and respondents with missing household income information were excluded from columns (9) and (10).

†  $p < .10$ ; \*  $p < .05$

**Table 9.** Examining the Effect of Abstinence on High School Completion After Controlling for Births, by Ability Level

Variable	All		Low Ability	Medium Ability	High Ability
	(1)	(2)			
Age at First Intercourse	0.046* (0.022)	0.037 (0.025)	0.049 (0.034)	0.052 (0.048)	-0.011 (0.042)
Childbearing at Age 18 or Younger		-0.160** (0.056)	-0.203** (0.069)	-0.039 (0.090)	-0.186* (0.090)
	[6,178]	[6,178]	[2,153]	[2,059]	[1,966]
<i>F</i> statistic on age of menarche (first-stage)	90.2	75.9	49.2	15.8	14.1

*Notes:* Standard errors corrected for clustering at the school level are in parentheses. Sample sizes are in brackets. Estimates are from weighted 2SLS regressions based on data from Waves I and III of the National Longitudinal Study of Adolescent Health. Although not shown, the controls listed in Table 2 and in Panel I of Table 6 are included. Respondents with missing PPVT information were excluded from the analysis. The low-, medium-, and high-ability categories were created by dividing the sample into thirds based on the PPVT distribution of respondents. The birth of a child at or before the age of 18 was determined based on information in the Wave III household roster.

\* $p < .05$ ; \*\* $p < .01$

strongest for respondents who were in the bottom third of the PPVT distribution. Specifically, for these respondents, delaying first intercourse by an additional year is associated with a .061 increase in the probability of high school graduation. For respondents in the top third of the PPVT distribution, delaying first intercourse by an additional year is associated with a (statistically insignificant) .005 *decrease* in this probability.<sup>24</sup> These results lend support for the hypothesis that high-ability respondents were better able to manage the time, psychological, and/or peer-related costs of becoming sexually active than were their lower-ability counterparts.

A similar pattern emerges when the sample is divided based on the educational attainment of the parent who completed the Adolescent Health parental questionnaire. Among respondents whose parent did not complete high school, delaying intercourse by an additional year is associated with a .073 increase in the probability of high school graduation, but the relationship between age of first intercourse and this probability is much weaker among respondents whose parent was better educated. Contrary to expectations, there is some evidence of a positive relationship between delaying intercourse and high school graduation among respondents from high-income families, whereas this relationship is positive but not statistically significant among respondents from low-income families.

Finally, in Table 9, we explore whether the abstinence effect documented in Tables 6–8 can be attributed partly or entirely to teen fertility. This issue has potentially important implications for the design of sex education curricula. If delaying first intercourse works entirely through the avoidance of teen births, then the impact on educational attainment of teaching adolescents to consistently and effectively use contraception would be similar to that of a successful abstinence program.

Controlling for fertility reduces the magnitude of, but does not eliminate, the estimated relationship between age at first intercourse and high school graduation. Among respondents who were sexually active at Wave III, the estimated effect of abstaining from sex for an additional year is reduced by about 1 percentage point (from .046 to .037) after we control

24. Although not shown, the estimated effect of abstaining from having sex until age 18 is also strongest for respondents in the bottom third of the PPVT distribution.



for having a child as a teenager.<sup>25</sup> Focusing on respondents who were sexually active at Wave III and in the bottom third of the PPVT distribution, the estimated effect of abstaining from sex for an additional year is also reduced by about 1 percentage point (from .061 to .049). Although we do not explicitly model the decision to have a child as a teenager, this pattern of results can be interpreted as evidence that abstinence impacts educational attainment through multiple routes, as opposed to working entirely through fertility.

## DISCUSSION AND CONCLUSION

In 1996, the federal government devoted limited resources to promoting abstinence among teens. By fiscal year 2006, federal funding for abstinence-only sex education through the Title V,<sup>26</sup> Section 510 Abstinence Education Program, the Adolescent Family Life Act (AFLA), and the Community-Based Abstinence Education Program had reached nearly \$180 million.

As federal funding for abstinence-only sex education has grown, so too has the need to assess its effectiveness. Recently, Trenholm et al. (2008) examined four Title V, Section 510 abstinence education programs by using a rigorous experimental design. They concluded that these programs had no impact on sexual activity or the likelihood of having unprotected sex, although there was some evidence that abstinence-only programs increased knowledge of sexually transmitted infections.

The work of Trenholm et al. (2008) casts doubt on the wisdom of spending more federal dollars on Title V, Section 510 abstinence programs as currently designed, but leaves open the question of how an effective abstinence program might impact the lives of adolescents.<sup>27</sup> Our study exploits person-specific differences in the biological onset of puberty to identify exogenous variation in age at first intercourse. The results suggest that delaying age at first intercourse by one year would result in a 4.6-percentage-point increase in the probability that adolescent females receive a high school diploma.<sup>28</sup>

One method of gauging the magnitude of this effect is to compare it with what we might expect to happen as a result of changes in presumably exogenous family background variables, such as parental education. For instance, according to our estimates, delaying first intercourse for three years would produce an effect on educational attainment comparable to that of having a parent who completed high school.

Another method of gauging the magnitude of the abstinence effect is to compare it with estimates obtained by researchers who have examined the effects of risky behaviors such as substance use on educational attainment. For instance, Koch and McGeary (2005) found that abstaining from alcohol use prior to age 14 resulted in a 7% to 22% increase in the probability of completing high school, and Yamada, Kendix, and Yamada (1996) reported that frequent marijuana use was associated with a 5.6% reduction in the probability of completing high school. Our work suggests that delaying first intercourse until age 18 is associated with a 28.5-percentage-point increase in the probability of graduating high

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25. Although not shown, the estimated effect of abstaining from having sex until age 18 is reduced from .285 to .224 after we control for teenage fertility. In alternate specifications, we included a set of variables that distinguished between births at different ages. The estimated effect of age at first intercourse on school attainment was nearly identical to that reported in Table 9.

26. This refers to Title V of the Social Security Act.

27. To be fair, there is an argument to be made that providing traditional sex education programs with more resources would be a mistake. Using data from the 1979 National Longitudinal Survey of Youth, Oettinger (1999) found that enrollment in a sex education course was associated with earlier sexual activity and an increased chance of becoming pregnant among females born between 1957 and 1964. See also Sabia (2006), who found that being offered a sex education course had no effect on adolescent sexual behavior or health outcomes.

28. This increase should be interpreted as a "local average treatment effect" (Imbens and Angrist 1994). A successful abstinence program could have a different impact on educational attainment, depending on whose sexual debut it delayed.

school. Because 83.3% of the respondents in our sample graduated from high school, this figure represents a 34.2% increase for the typical female in the sample ( $28.5 / 83.3 = .342$ ).

The estimated effect of delaying first intercourse appears to be largest for adolescent females already at a disadvantage in terms of cognitive ability. Among respondents in the bottom third of the ability distribution, delaying first intercourse for an additional year is associated with a .061 increase in the probability of high school completion. For higher-ability respondents, the estimated abstinence effect is much weaker, perhaps because they are better able to cope with the costs of becoming sexually active.

Finally, we found that for the average Adolescent Health respondent, controlling for teenage fertility reduces the estimated relationship between abstinence and educational attainment by approximately 1 percentage point, or by one-third; for respondents in the bottom third of the ability distribution, controlling for teenage fertility also reduces the estimated relationship between abstinence and educational attainment by approximately 1 percentage point. These estimates can be interpreted as providing evidence that the effect of abstinence on educational attainment is not entirely driven by fertility, and suggest that abstinence provides an important benefit that "safe sex" does not.

In addition to fertility, there are other potential pathways through which abstinence might impact educational attainment. As Rector and Johnson (2005) noted, one such pathway is the avoidance of psychological or emotional harm. In fact, there is evidence that females who become sexually active at an early age are at greater risk of exhibiting the symptoms of depression (Hallfors et al. 2005; Rector, Johnson, and Noyes 2003; Sabia and Rees 2008).

Peers, too, may act as a mediating factor. Because the Adolescent Health data contain information on friends and classmates, the potential exists for future researchers to address the extent to which abstinence works through peer interactions. However, pinning down the existence and magnitude of peer effects has proved, in general, to be a difficult task and is beyond the scope of this article.<sup>29</sup>

Future work might also address whether other sexual behaviors are related to abstinence and educational attainment. There is evidence that an early sexual debut leads to more frequent sexual encounters (Kahn et al. 2002) and a greater number of partners (Sandfort et al. 2008). Research by Arcidiacono, Khwaja, and Ouyang (2007:29) suggested that first intercourse involves a fixed cost, such as crossing a "moral or psychological barrier," but that after this barrier is crossed, adolescents rarely revert to abstinence. Explicitly incorporating these dynamics into future work could enhance our understanding of why delaying first intercourse is related to educational attainment.

In summary, the results of our study indicate that delaying first intercourse leads to an increased likelihood of graduating from high school. However, translating this conclusion into effective policy requires the implementation of a curriculum to which adolescents will respond, a goal that has eluded most federally funded abstinence-only sex education programs.

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29. A researcher interested in estimating the influence of peers is faced with a number of major hurdles (Manski 1993). For instance, a correlation between the likelihood that an adolescent is sexually active and the percentage of her peers who are sexually active may be evidence of a peer effect, but it is also possible that it is driven by shared school-level attitudes.

**Appendix Table A1. Means of Dependent and Independent Variables**

Variables	Mean	SD
Dependent Variables		
Received a high school diploma (excluding GED)	0.833	0.373
Attend college	0.620	0.485
Abstinence Variables		
Age at first intercourse <sup>a</sup>	16.4	2.19
Abstain until age 18	0.381	0.486
Instruments <sup>b</sup>		
Age of menarche	12.6	1.67
Whether school provided or referred students to family planning services	0.562	0.496
County family planning providers per 10,000 population	0.299	0.390
Presence of an abortion facility in county that provided 400 or more abortions	0.481	0.500
Control Variables		
Age at Wave III	21.7	1.83
Log of household income	10.5	0.813
Parent completed high school	0.325	0.468
Parent attended trade school	0.097	0.296
Parent completed some college	0.184	0.387
Parent completed college	0.136	0.343
Parent has a post-college education	0.090	0.286
Parent is single	0.053	0.225
Parent is divorced	0.138	0.345
Parent is separated	0.046	0.210
Parent is widowed	0.030	0.170
PPVT Score	100.0	14.7
Rural	0.157	0.364
Suburban	0.580	0.494
West	0.163	0.370
Midwest	0.320	0.467
South	0.381	0.486
Catholic	0.241	0.427
Baptist or Methodist	0.391	0.489
Other Christian	0.208	0.406
Non-Christian religion	0.045	0.208
Black	0.163	0.369
Asian	0.035	0.185
Indian	0.035	0.185
Hispanic/other	0.118	0.323
Height (inches)	64.2	2.97
Weight (pounds)	130.5	29.3

(continued)

(Appendix Table A1, continued)

Variables	Mean	SD
Control Variables (cont.)		
Class size	25.5	4.93
Public school	0.940	0.236
% Enrolled in college preparatory courses	44.5	31.5
Small school size	0.169	0.375
Medium school size	0.451	0.498
Number of biological siblings	1.53	1.39
Whether has an older sibling	0.485	0.500
Very unattractive	0.021	0.144
Unattractive	0.039	0.193
Attractive	0.369	0.483
Very attractive	0.201	0.401
Childbearing at age 18 or younger	0.082	0.175
Severely underweight	0.060	0.238
Underweight	0.028	0.165
Overweight	0.144	0.351
Obese	0.086	0.280
Bulimia	0.039	0.193

Notes:  $N = 7,444$ . Means are weighted.

<sup>a</sup>Age at First Intercourse is restricted to those who were sexually active by Wave III ( $N = 6,555$ ).

<sup>b</sup>For instruments, the sample is restricted to nonmissing observations ( $N = 7,308$ ).

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